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Ontogenesis as a model for design processes

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Abstract: The technical rationality (TR) and reflective practice (RP) paradigms have heavily influenced thinking about design and design cognition in the 20th century. This paper concisely highlights some of the features and limitations of these paradigms. In particular, it develops the suggestion that we require a new "root metaphor" or leading set of concepts to develop our thinking about designing beyond the work of Donald Schön. Building on this assumption, this paper examines some useful aspects of selected concepts developed by Gilbert Simondon, in particular the notion of ontogenesis. Furthermore, it is argued that Simondon's thought helps us to connect epistemology to the fluidity of lived experience. The suggestion is made that a so-called ontogenetic approach is better suited to deal with the inevitable fluidity and developmental character of experience itself, and that this could be new approach for thinking about design processes.

Keywords: reflection-in-action; design cognition; ontogenesis; epistemology

1. Introduction

Knowledge claims about design situations are usually made from an immersed perspective, informed by lived experience. Nowhere else is this explained more clearly than in the work of Donald Schön (Schön 1983; Schön 1992). While Schön emphasized the importance of lived experience in reflectively judging design situations, his account left untheorized how (a) experience and epistemology interact, and (b) how development of a knowledge base is dependent on a prior account of how experience develops. If we have a reasonable picture of how design experience develops and relates to the accumulation of knowledge, we might fill in the gap that Schön identified.

Schön's ideas have reached the status of "root metaphors" that underlie thinking about design as such, because they form an indispensable part of an established canon of ideas. A root metaphor is a structuring image or analogy that forms the base for an entire line of theorizing. (Pepper 1942). Pepper's own example is that of the Presocratic philosopher Thales, who postulated that everything in the world resembles water. The root metaphor "water" is used to explain, theorize about and characterize phenomena in the physically real world (Pepper 1942, p. 92-93). As such, it is an underlying image or thought-shaper (Hanna and

Paans 2021) that shapes and directs thinking. But equally, it gives rise to deeply set habits of thought, some of which are constraining rather than helpful.

Schön's "reflection-in-action" was a genuine novel approach, but the danger of clinging too closely to a root metaphor is that its weaknesses are overlooked and only seldomly questioned.

In this paper, I raise the suggestion that we require a new "root metaphor" or model for thinking about design processes, and in particular how knowledge accrues in them. This new root metaphor is centred around the concept of "ontogenesis", informed by the work of the French philosopher of technology Gilbert Simondon (1924–1989).

Immediately, we must address a critical question: what problem does this new root metaphor solve? Put concisely, it is the issue of a blind spot in the way that the *development of experience* in design processes and design cognition has been theorized under the influence of successive research paradigms in design theory. Schön's 1983 study *The Reflective Practitioner* (Schön 1983) demonstrated the dependence of design insights on experience but left the development of experience itself undeveloped. This is of crucial importance for design epistemology. One way in which this problem surfaces is the role than verbalization plays in Schön's account. After reading Schön, one could almost come away with the idea that everything important about a design process could be verbalized and discussed between competent professionals. However, this picture is not entirely accurate. Emotions, affects and sheer "gut feeling" cannot easily be verbalized, but they play decisive formative roles in designing. Indeed, the picture that Schön paints about architectural education and the role studio practice is sometimes one-dimensional, overemphasizing exchanges in the studio, thereby unwittingly reinforcing the idea of the designer as the sketcher who "massages" problems until inspiration strikes (Ó Catháin and Mann 2009).

Epistemological claims often refer to the conditions under which a given insight or piece of knowledge was obtained, emphasised by approaches like contextualism (Ball 2017; Pynn 2015). As such, the notion of lived experience becomes of crucial importance if we are to evaluate knowledge claims with sufficient clarity and precision. As experience is an occurrent and organically developing phenomenon, the accompanying epistemology must reflect something of this growth process. In claiming this, we follow a line of thinking that stresses the fact that the models utilized to address a given question must follow the phenomenon under examination. Put differently: applying a generic model to a specific question leads often to conceptual problems and mismatches.

Therefore, in section 2, I explicate some key characteristics of the technical rationality (TR) and reflective practice (RP) paradigms. This exposition should be read as a synoptic analysis of a selection of core concepts that structure our thinking about design.

In section 3, I sketch out a new root metaphor, intended as a model for renewed thinking about design activity. This root metaphor centres on the notion of "ontogenesis", derived

from the thought of Gilbert Simondon. I explain its features and advantages and show how it may be used to move beyond the limitations of the TR and RP paradigms.

In the concluding section 4, I sketch some developmental possibilities of the ontogenetic root metaphor, although my account cannot be complete or exhaustive.

2. Two root metaphors of design processes

The perennial predicament for every form of thinking is that it must start from some presuppositions. Nowhere is this better visible than in the scientific paradigms used as models to think about designing during the second half of the 20th century.

The technical rationality (TR) paradigm utilized during the 1960s and 1970s was in the early 1980s superseded by the reflective practitioner (RP) paradigm, introduced by Donald Schön (Schön 1983). In turn, the insights formulated by Schön fed into the developing design science from the 1990s and the early 2000s (Buchanan 1992; Cross 2007; Dorst 2003; Erlhoff 2013; Lawson 2004, 2005).

If we wish to retrace the roots of the TR paradigm, we must start after the Second World War, when developments in mathematics, logic and the emerging computer sciences deeply influenced views on human problem solving. This development mirrored an unbridled confidence in the dual doctrines of *logically-driven mathematization* (exemplified in the work of John von Neumann, Norbert Wiener, John Nash, and the MIT/Princeton research axis) and *natural mechanism* (the doctrine that all physical reality can be approached as more-or-less complex automata, all of whose operations and quantitative properties can be calculated on an ideal digital computer).

Building on the twin ideas of natural mechanism and logic-driven mathematization, design processes were largely framed as decision-sequences during the 1960s and 1970s (Hanna and Paans, 2020). The core idea was that design decisions were utilized to explore a given problem space, and that the sum total of decisions constituted a rational design process. Allen Newell even regarded the problem space as the “fundamental category” of design (Newell 1979). Here, we see the root metaphor “mechanism” at work. (Pepper 1942, p. 186–188). If the world is framed as a machine, and when biological organisms are framed as complex automata, then it is only a small step to regard the brain as a supercomputer, and to frame thinking processes as computing (or computable) processes. With this commitment to mechanism, emerges a propensity to cling to what Buchanan (1985, p. 9) has called “technological reasoning”. That is, the type of reasoning that focuses on the instrumental and technical values of design practice.

This methodological choice reduces design activity to mere problem solving, and consequently questions about the nature of problems emerge. After all, to solve a problem, one must define it. This issue gave rise to an extensive literature. However, notions like “wicked problems” (Rittel and Webber 1973), “ill-structured problems” (Goel 1992a, 1992b, 1992c; Simon 1973), “superwicked problems” (Levin et al. 2012) and “anarchic nets” (de Bruyn and

Reuter 2011) did little to answer the original issue: how can one solve a problem that is not clearly demarcated?

One promising response was to regard problems as decomposable entities: through careful analysis, a given problem could be *disassembled* in its constitutive parts. Simultaneously, this idea gave rise to its natural counterpart: if ideas consisted of simple parts, designing amounted to *assembling* discrete components (Asimow 1962; Bamford 2002, p. 252). But the idealization of technological reasoning proved to be constraining for thinking about design.

A breakthrough in this impasse was Dorst's observation that problems and solutions co-evolve (Dorst 2003). In one gesture, the relation between a problem and a response was redefined as a process of mutual definition and dynamic demarcation. Likewise, Buchanan's concept of "placement" proposed that designers utilize a preliminary orientation towards an issue or set of issues that must be addressed (Buchanan 1992). The placement applies as it were background knowledge in rough-and-ready approach that fixes a point of departure. Both Buchanan's and Dorst's approaches rejected from the strict distinction of problem definition and solution.

Conversely, the TR paradigm treated human problem-solvers largely as rational optimizers, a kind of idealized *homo economicus*. This idea had already gained intellectual respectability in the work of philosophical positivism and the CIAM-styled modernistic approach to architecture alike. (Paans 2019b; Hanna and Paans 2020). In the TR-paradigm, the designer makes crucial distinctions and gradually narrows down an impossibly large array of choices and options (Kunz and Rittel 1972; Rittel 2014). Conversely, these bits and pieces are synthesized in variations that each respond to an initial problem. In subsequent cycles of evaluation, the options are once again weighed, and new cycles of targeted analysis or synthesis are initiated.

In this picture, sociological, affective, emotive and practical aspects of design are curiously absent. We are left with the question what kind of role lived experience actually plays for the designer, especially against the background of Buchanan's assessment that design arguments derive their substance from technological reasoning, character and emotion (Buchanan 1985, p. 9). But if the focus is only on the first aspect, this result in an obvious lacuna:

> The argument in each is only partly controlled by mechanical premises, and if the logos or reasoning of the design is reduced to mechanics alone, the designer's real argument, which is a unique synthesis of mechanical and human premises, is lost. (Buchanan 1985, p. 10–11).

This lacuna prepared the ground of Schön's contribution to design theory. Before delving into the RP paradigm, it suffices to highlight two further points about the TR paradigm:

1. In the TR paradigm, design processes are conceptualized as sequences of consecutive decisions (Buchanan 1995, p. 43). These moments are connected by episodes of analysis, evaluation and synthesis. One would be justified in asking whether this depiction is not a *post hoc* idealization. A sequence of stages is suggestive of clear demarcations, while reality itself is inevitably more fluid.
2. In the TR paradigm, the accumulation of insights is confined to fixed points in the design process; for instance, a demarcated moment of "evaluation" leads supposedly to new insights, and these are consequently utilized in an episode of "synthesis". In reality, uncovering insights is an occurrent phenomenon due to the fact that experience unfolds continuously and non-linearly.

Schön coined two instrumental ideas: (1) the idea that designers develop a design proposal "in conversation" with the situation, and (2) the idea that designers utilize "reflection-in-action" to accomplish this. The influence of this approach can still be witnessed in notions like epistemic dissonance (Farias 2013), serial sketching, linkography (Goldtschmidt 1991; 2014) and discursive pragmatics (Girard and Stark 2002).

Schön's method consists in glimpsing over the shoulder of the designer at work and connecting the moves she makes to her notional world. This is a far cry from the abstract, process-oriented nature of the TR paradigm, as it opens up towards the first-person viewpoint of the designer and the tactics she deploys. The case that is usually cited takes place in a design studio, between an architecture teacher (Quist) and his student (Petra) who encounters a design problem. In responding, Quist thinks aloud while simultaneously drawing sketches that represent his thoughts, visually and spatially reframing the problem she presented him. During the conversation, whenever Quist encounters a problem, he starts to sketch, specifying leading ideas or generating alternatives for issues. However, this generation of alternatives is not just a heuristic exercise in technical reasoning.

If anything, it is the organic development of a "thick" language game spanning across visual, emotive and grammatical modes of expression. Because the resulting language consists of a combination of verbal utterances and non-verbal media such as sketches or models, it is richer in expression than purely linguistic structures. It is "semantically saturated" – i.e. open to different interpretations simultaneously and sequentially (Lawson 2004, p. 76; Suwa and Tversky 2003). But above all, it is somewhat opaque and open-ended, so that new interpretations can be "read into it" or derived from it.

The exploratory logic of the designer at work has often an "*if…then*" form. For example, *if* we choose to make a certain area of the city car-free, *then* we will see an increase in the use of public transport. These "if-then" statements are essentially conjectures, but simultaneously playful speculations, or precise investigations of a single issue. The activity of "free conjecturing" opens out onto experience, a point I will return to in the next section.

Schön's contribution lies in moving away from the abstract, decision-theoretic approach of the TR paradigm, focusing instead on the direct experience of designers as they design. However, it left a gap for design epistemology as experience is by definition fluid, developing and unstable, while models are fixed, abstract and of a sometimes overidealizing nature.

That being said, the discourse about design knowledge is no stranger to the idea of instability. Confronted with the apparent lack of standards and plurality of notions, Wolfgang Jonas once stated that designers must embrace the instability and must learn to "love the swamp of uncertainty" (Jonas 2013). True as that advice may be for the practitioner, it gives preciously little handholds to the academic who aims to set up epistemological reference points. However, by considering a selection of concepts from the work of Gilbert Simondon and adapting them as thinking tools for the design discourse, we might find our way out of the swamp.

3. Ontogenesis: The nature of experience

To move our thinking about design processes beyond Schön, we require models that focus on the unfolding of experience. But then, such models require an underlying "root metaphor" suited to deal with instability, impermanence, fluidity and developmental patterns. So, the very first task is to come up with a new conceptualization of design processes, notably one that can give rise to models that address fluidity and instability.

The new root metaphor must therefore:

1. adequately represent the *fluid* nature of design experience, by not framing it solely in terms of rational decision-taking (as in TR) or competent (professional) verbalizing, judging and reflection (as in RP).
2. recognize the *conjunctive* character of experience (James 1904). Simply put, we seldom experience only one thing at a time. We hear the keyboard under our fingers, the rain against the window and we see the glow of the lamp on the desk. All these features enter our consciousness at slightly different time intervals, but we experience them as being part of the same scene or part of a coherent, continuous and intelligible experience.

Our brains possess the capacity to update this rich, conjunctive texture in real-time as we move our gaze or change position (Dennett 2003). The separate impressions that make up the tapestry of our experience are perceived as spontaneously forming relations with each other in the so-called "mental workspace" (Baars 1996, 1997; Dehaene 2014, pp. 163–165). If they did not, our experience would be a rather chaotic. Professional training shapes this integrative capacity. For instance, a landscape architect or engineer might read things in a landscape that elude the innocent onlooker:

> The gaze of the construction engineer surveys the landscape and recognizes that a certain valley may be crossed by a bridge with a large overarching structure, while a landscape planner appreciates the silence and untouched beauty of the same situation as

> its most valuable characteristic, and an architect imagines how beautifully embedded his settlement design would look in the same valley…(De Bruyn and Reuter 2011, p. 89).

The landscape architect or engineer combines features of her experience with technical knowledge. Consequently, entities like bridges or electricity lines appear to her not just as nondescript, generic entities, but as technical objects. This feature holds for finished objects, just as much for objects that are being designed. Objects that are represented in the course of a design processes are "fictional objects" or *analogons* – that is, the affective and imaginative counterparts that support, shape and inform our experience. (Currie 1990, 1995; Sartre 2004, p. 61–69).

The TR paradigm often skimmed lightly over these affective and emotive characteristics of designing, even while it is obvious that "eureka moments" and episodes of frustration are part and parcel of it. Affective factors like surprise, enthusiasm and idealism are just as much influences as rational motives. While the RP paradigm recognized the importance of the interplay between designer and artefact, it said little about the first-person nature of experience, emphasizing "competent judgement" by the designer instead. But it is the fluency and conjunctive character of first-person, embodied experience that makes reflective judgements possible. Consequently, RP elucidates individual operations by which knowledge is acquired but cannot provide a theoretical base for it.

Epistemologically, this presents a problem, as individual observations on reflective design practice – no matter how useful – do not automatically coalesce into a theory. If we structure all discrete observations in a coherent framework, we remain stuck at the level of defining practical design rules, without knowing *why* they work. Conversely, if we take the conjunctive character of experience as point of departure, we circumvent this problem.

For a richer image or "root metaphor" that takes lived experience and its developmental influence fully into account, I examine some concepts by Gilbert Simondon. It should be emphasized that the focus of this discussion is restricted, and that the thought of Simondon obviously extends well beyond the concepts discussed here.

Initially, Simondon developed the notion of *ontogenesis* for describing the nature of technological development. He noticed that technical objects like the combustion engine could be fruitfully analysed by taking their genesis into account, including problems and issues that were inherited from one model to the next. But equally, he noticed that the way in which individual parts acted determined and were determined by their environment. Significantly differing from cybernetic models by McLuhan and Wiener, Simondon held that the key to the problem of development was not (just) located in how information was distributed in a process of decision-making (or reflectively judging), but that it could be approached from the angle of genealogical-ontological development, an approach he termed *ontogenesis:*

> The term "ontogenesis" receives its full sense if, instead of giving it the restricted and derived meaning of the genesis of the individual (in opposition to a greater genesis: that of the species for example), one uses it to designate the character of becoming of

> being, that by which being becomes, insofar as it is, as being. The opposition between being and becoming can only be valid within a certain doctrine that supposes that the very model of being is a substance (Simondon 2009, p. 5–6).

Although his terminology differs, Simondon comes surprisingly close to Schön's account of progress in design processes, as reflective practice is a recognition of the fluid and unstable character of design activity. But Simondon provides an additional step that extends Schön's initial argument: he introduces the notion of ontogenesis *into* the process of becoming. That is, he provides an account of the "becoming of being" and is therefore in a position to think systematically about the seemingly ungraspable fluidity of experience. Instead of focusing on the sequence of decisions or judgements, Simondon takes a broader view, and views the developmental process as an organic whole.

To bridge the gap between the Platonic realms of being and becoming, Simondon coins the neologism *metastability*:

> [Simondon] claims that in antiquity (…) there were only the presupposed notions of instability and stability, or movement and rest, but nothing that existed in between or beyond these concepts. Thus, to consider being was to consider an implicit state of stability. (Bluemink 2020; Simondon 2009, p. 6).
>
> In its most basic formulation, metastability refers to a state that transcends the classical distinction between stability and instability. Deleuze summarises that "what essentially defines a metastable system is the existence of a 'disparation,' the existence of at least two different dimensions, two disparate levels of reality, between which there is not yet any interactive communication". In other words, a system is meta-stable in that it is not truly stable yet not entirely unstable (Bluemink 2020; Deleuze 2013, p. 89).

So, instead of accepting the Platonic opposition between becoming (dynamic) and Being (static), Simondon collapses the dichotomy, and considers the in-between realm that connects the two. The upshot is that systems do not need to be either stable or unstable. They can be open and in development, and we can accept that as a constitutive property of them.

If we apply this thought to design practice, Simondon's abstract formulation of metastability turns out to be quite accurate description of objects that are being designed. Such objects are stable in the sense that some of their properties are fixed or retained during successive cycles of development. Yet, they are also unstable because that they are open and actually developing (Whyte and Ewenstein 2010; Bardin 2015: 56). Artefacts curiously unite stability and instability in a single metastable entity.

By collapsing the distinction between being and becoming, Simondon suggests that *to become* is continuous with being. We tend to equate being with stability and becoming with instability or flux. But once we think of these notions as continuous, we can see how this move enables Simondon to claim that objects and individuals alike are naturally shot through with *potentiality*, but equally with *relationality*. Some of their aspects are stable, while some others are simultaneously unstable. But at any moment, a designer might

change this fragile order. And exactly in that metastability lies the possibility to capitalize on as yet unrealized potentials.

For designers, the notion of potentiality is familiar. A design process can be seen as a series of attempts to discover and realize potentials that reside in an initial idea. Ideas can develop and influence their surroundings in many ways; in turn, their surroundings shape them. Simondon calls this the *pre-individual component* of an entity: an object or entity may exist as an inchoate mass of potentials, but only once these potentials crystallize into something tangible, something truly individual emerges.

So, the metastable entity can be seen as a field of potentials that can developed in various directions, but that at the same time possesses a homeostatic (i.e. dynamic) balance:

> All these elements, however, participate in a ground that gives (…) a homeostatic unity, and which acts as a vehicle for informed energy from one to the other and among all of them. (…) This ground is the mental milieu associated with the forms. It is the middle term between life and conscious thought, just as the associated milieu of the technical object is the middle term between natural world and the fabricated structures of the technical object. We can create technical beings because we have within us a play of relations and a matter-form relation that is highly analogous to the one we constitute in the technical object (Simondon 2017, p. 62).

By freely moving between the realms of living and non-living entities, Simondon makes a claim about the relation of experience to our inventive capacities. Because we possess a "play of relations and a matter-form relation" are we able to invent and to design. (Simondon 2008). Consequently, the process of individuation cannot be understood apart from relationality, as the "limit" of the individual constitutes its interface with the external world. But in many cases, this boundary is porous. And like the relation between individual and environment, we better understand the relation between object and context as continuous. Or put differently, as an entanglement rather than a hard barrier.

To maintain that we possess a "play of relations and a matter-form relation" is a claim about the nature of experience. Schön's "reflective practitioner" is engaged in a process of retracing his steps and making judgements based on a thoroughly situated, context-sensitive method of knowing and exploring. But, as discussed, if we restrict our theory to the level of useful practical observations, we have made only the first step.

Simondon moves here beyond Schön's reflection-in-action, as he maintains that (I) the nature of our experience, (II) the metastable character of artefacts, and (III) the continuity between object and context are highly analogous in nature. So, we are *neither* dispassionate agents, *nor* competently judging professionals. Instead, we overlap and entangle with the artefacts we design. They look a lot more like us and we look a lot more like them than the TR and RP paradigms suggest. Simondon is insistent that the experiential dynamics we apply in creating technical objects is reflected in them:

> The dynamism of thought is the same as that of technical objects; mental schemas react upon each other during invention in the same way the diverse dynamisms of the

> technical object will react upon each other in their material functioning. (Simondon 2017, p. 60)

But even if we grant this point, how does this congruence between the dynamism of our experience and the objects it conceives play out? Another of Simondon's concepts can be of help to advance clarify this point, namely *transduction*:

> By transduction we mean an operation--physical, biological, mental, social--by which an activity propagates itself from one element to the next, within a given domain, and founds this propagation on a structuration of the domain that is realized from place to place: each area of the constituted structure serves as the principle and the model for the next area, as a primer for its constitution, to the extent that the modification expands progressively at the same time as the structuring operation (Simondon 2009: 11).

The transductive "operation of propagation" is again recognizable for the designing mind. In the literature this spontaneous-yet-directed activity goes by many names: "bridging", "co-evolving" or "structuring-solving" (Dorst and Cross 2001, p. 432; Restrepo and Christiaans 2004) "framing" (Dorst 2015) or simulating (Paans and Pasel 2020). In architectural design, its mobile, rhizomatic and migratory properties can be witnessed in the "scale jumps" that range from detail to overall concept to an overarching systemic vision and back again. (Paans, 2019a).

Framing transduction as a process as *either* a process of rational decision-taking or competently judging is unnecessarily limiting and misleading. Likewise, designing is definitely more than *either* decision-making or judging. Instead, it has more in common with an immersive performance in which no structure is taken as primary, but in which each thought, *leitmotif*, system or structure can be taken as point of departure for targeted experimentation. As some elements of an idea or object serve as "primers" for new elements, we can say that acts of modifying are simultaneously actions of dynamically structuring the various components of an idea. Each change brings new potentials and relations into the foreground. Sometimes, these changes are deliberately planned through professional judgement. But just as often, such changes occur as flukes, surprises or unintended side effects.

The affective, emotive, technical and rational capacities of the human mind all play roles in gradually conceiving artefacts, objects and ideas. However, the process of form-seeking or form-defining is centred on "signifying form":

> [t]he Good Form is no longer the simple form, the pregnant geometric form, but the signifying form, that is, that which establishes a transductive order within a system of reality that contains potentials. This good form is that which maintains the energy level of the system, that which conserves its potentials by rendering them compatible: good form is structure of compatibility and viability, it is the dimensionality that is invented and according to which there is compatibility without degradation (Simondon 2009: 11).

The *form* is not the physical appearance, that aesthetically pleasing object, or that all-encompassing "master idea" that solves all practical problems. And neither is it the "primary

generator" that artificially superimposes a structure on a given problem (Darke 1978). Instead, the form is that tangible order which emerges through the various registers of embodied experience, and large parts of which are non-conceptual, affective and open-ended.

Equally, the "signifying form" is not a symbol that signifies a reality beyond itself. Instead, it is the appearance of the tangible order that creates a "shock of recognition", a moment in which the designer realizes that there is a deep and thoroughgoing congruence between the issues she works on and the constitution of her response – an *appropriateness* that goes well beyond aesthetic pleasure or functional utility (Nelson 1983, p. 10). To some degree, this moment is implicitly expected to arrive, but when it does, its advent is often surprising – it is the "expected unexpected" (Nelson and Stoltermann 2014: 41–42).

An excellent early example of thinking about "good form" is Kevin Lynch's treatment of "good city form" in his study of the same name (Lynch 1984). Instead of prescribing one definite form for the ideal city, Lynch considers a number of boundary conditions within which the "good city" operates. What is striking is the variety and versatility of Lynch's discussion. In a truly genealogical manner, he traces out a network of overlapping concepts like Justice, Access, Vitality and Efficiency, never settling for a simple formula, but bringing their relations into the foreground.

Quite often, the design idea that provides the inroad towards a solution is still open-ended, but it gives a direction to all subsequent developments. Conversely, it is possible to see how often, an initial idea is in an embryonic form present in early design stages, only to change shape later on, with an often-breathtaking versatility.

4. Conclusion

I started this paper with the assertion that Simondon's thought could be of help in moving beyond Schön's account of design processes, especially by connecting epistemology to experience. Although this is not the place to provide a full Simondonian research programme, I highlight two ways in which Simondon's concepts can be utilized:

1. Schön's reflective practitioner competently judges design situations and evaluates design situations, but we obtain little information on how this capacity develops over time. Like "decision-taking" in the TR paradigm, "reflection-in-action" has a limited scope of application. By contrast, Simondon's concept of transduction shows *how* the designing mind utilizes a "propagating activity" that freely moves across various elements. Combined with the claim that we possess an inherent affinity for inventing "matter-form" relations, we have a powerful set of conceptual tools to create a new theoretical framework for designing. If we follow the Simondonian line of thought, we start from the fluidity of experience, which translates into a "propagating activity" with which we explore design situations through "thick semantics", ratiocination, affect, emotion and immersion. Instead of starting from a mediating concept like "decision-taking" or

"reflection-in-action", we stay as close to the spontaneous and multifaceted nature of experience as possible and try to derive our operative concepts from there.

2. Epistemologically, mediating concepts like "decision-taking" or "reflection-in-action" locate the accumulation of insight at certain moments or episodes in the process. For instance, the ideal rational optimizer of the TR paradigm "synthesizes" all prior findings into a new solution at a given moment in the process. Likewise, an ideal "reflective practitioner" teases out various consequences of an idea and competently judges the result in an episode of "conversing with the situation". Of course, such episodes might occur in design processes, but the process in its entirety is not reducible to them. When designing, we might experience a "eureka moment" now and then, but just as often, knowledge accumulates gradually and works in a way that is transductive (i.e. freely and nonlinearly connecting ideas and fragments) and ontogenetical (i.e. genealogically integrating those fragments into new constellations). A very early insight in a design process might re-emerge once a proposal has advanced considerably. Or, the same idea keeps coming up again in different guises. But epistemological models derived from the TR and RP paradigms are ill-suited to represent such situations properly.

An ontogenetic account of design processes takes a different perspective: there are no overarching, idealizing models of design activity that do justice to the richness and conjunctive character of experience. We can follow and trace out the "propagating activity" that is operative in shaping ideas and that drives the process of exploration and connection of seemingly disparate notions.

This does not mean that we must discard all foundations and that we are condemned to wander "the swamp of uncertainty". That would lead to an unconstrained and ultimately unhelpful relativism. Instead, it means that we must not seek handholds in mediating concepts, but in emphasizing a full-blown, rich and layered picture of experience to discuss knowledge claims. Once we do so, we can conceive of experience as the place (*topos*) where new ideas and concepts are allowed to emerge, and knowledge accumulates in a genealogical and transductive manner, often eluding description by models that are too static. Of course, the suggestion raised here is concise in the extreme, but offers numerous possibilities for development.

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